Oregon Global Warming Commission

Our Role Today and Into the Future

October 30, 2020

NW Natural®

Agenda

Topics:

1. Overview & Upstream Methane
2. E3 - Decarbonization Study
3. Renewable Natural Gas & Power to Gas
4. Learnings from Europe & Closing
5. Q&A

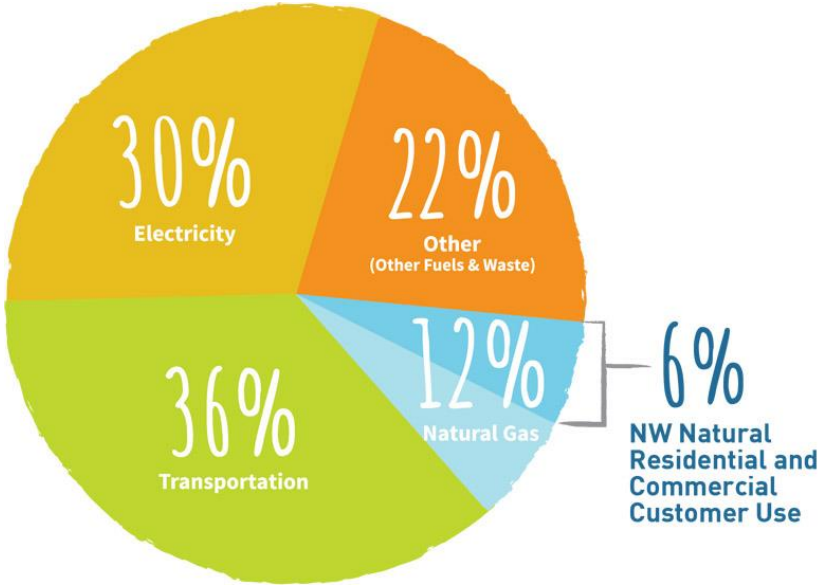
Overview
&
Upstream Methane

Role of Our System

NW Natural's System:

- Delivers more energy than any other utility in Oregon
- Heats 74% of residential square footage in the areas we serve
- Provides 90% of energy needs for our residential space and water heat customers on the coldest winter days
- Is one of the tightest, newest systems in the country

Oregon Greenhouse Gas Emissions



Source: ODEQ In-Boundary GHG Inventory 2015

Upstream Emissions are Not Unique to Natural Gas

Comparing the direct emissions of one source against the lifecycle emissions of another compares apples to oranges

Table A.III.2 | Emissions of selected electricity supply technologies (gCO_2eq/kWh)[i]

Options	Direct emissions	Infrastructure & supply chain emissions	Biogenic CO_2 emissions and albedo effect	Methane emissions	Lifecycle emissions (incL albedo effect)
	Min/Median/Max	Typical values			Min/Median/Max
Currently Commercially Available Technologies					
Coal—PC	670/760/870	*9.6*	*0*	*47*	**740/820/910**
Gas—Combined Cycle	350/370/490	*1.6*	*0*	*91*	**410/490/650**
Biomass—cofiring	n.a.[ii]	–	–	–	**620/740/890**[ii]
Biomass—dedicated	n.a.[ii]	*210*	*27*	*0*	**130/230/420**[ii]
Geothermal	0	*45*	*0*	*0*	**6.0/38/79**
Hydropower	0	*19*	*0*	*88*	**1.0/24/2200**
Nuclear	0	*18*	*0*	*0*	**3.7/12/110**
Concentrated Solar Power	0	*29*	*0*	*0*	**8.8/27/63**
Solar PV—rooftop	0	*42*	*0*	*0*	**26/41/60**
Solar PV—utility	0	*66*	*0*	*0*	**18/48/180**
Wind onshore	0	*15*	*0*	*0*	**7.0/11/56**
Wind offshore	0	*17*	*0*	*0*	**8.0/12/35**

We support consistently applied lifecycle carbon accounting.

But adding **this figure** while ignoring **the rest of the figures in the green box** is inaccurate.

Source IPCC: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf#page=7)

Value Chain Progress

Natural Gas Value Chain Emissions Reported by EPA: 1.3%

North American leakage rates in decline

- Colorado and Canada, the source or our supply, have the most stringently regulated production
- Large producers driving change through process, procedures and executive comp ties to reductions

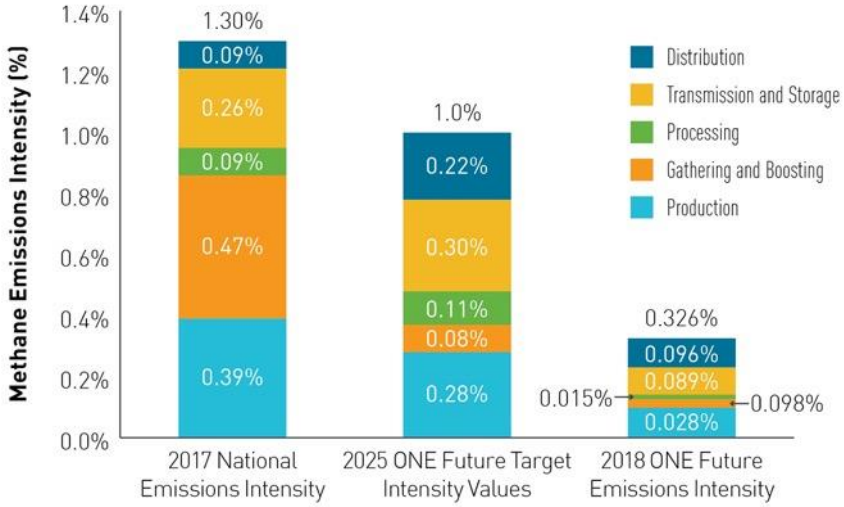
Industry accelerating innovations

- Visual imaging cameras, sensors onsite and in drones for faster detection / repair, tankless liquids unloading

NW Natural carbon intensity scorecard

- Using EPA data to evaluate relative carbon intensity of supplies by producer
- Allows our purchasing decisions to be informed by environmental impact

ONE Future Results – Exceeded Goal Below 1%



E3 - Decarbonization Study

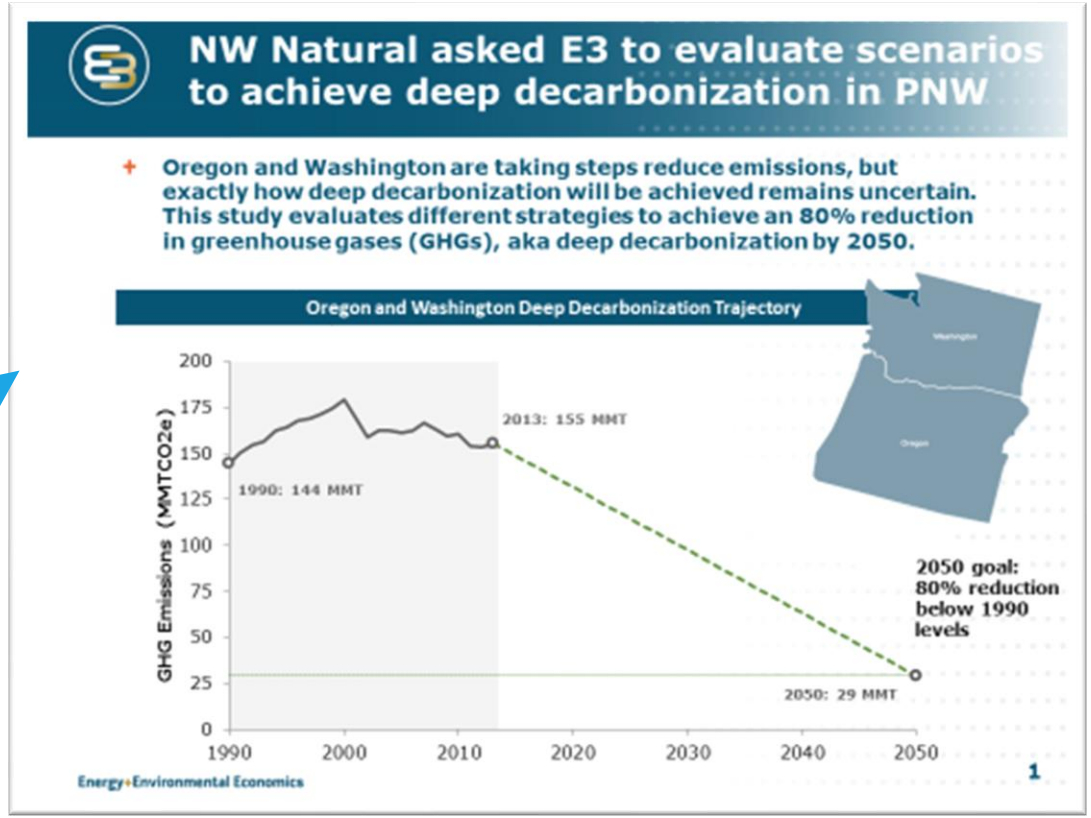
Northwest Deep Decarbonization Study

Focusing on Role of Buildings

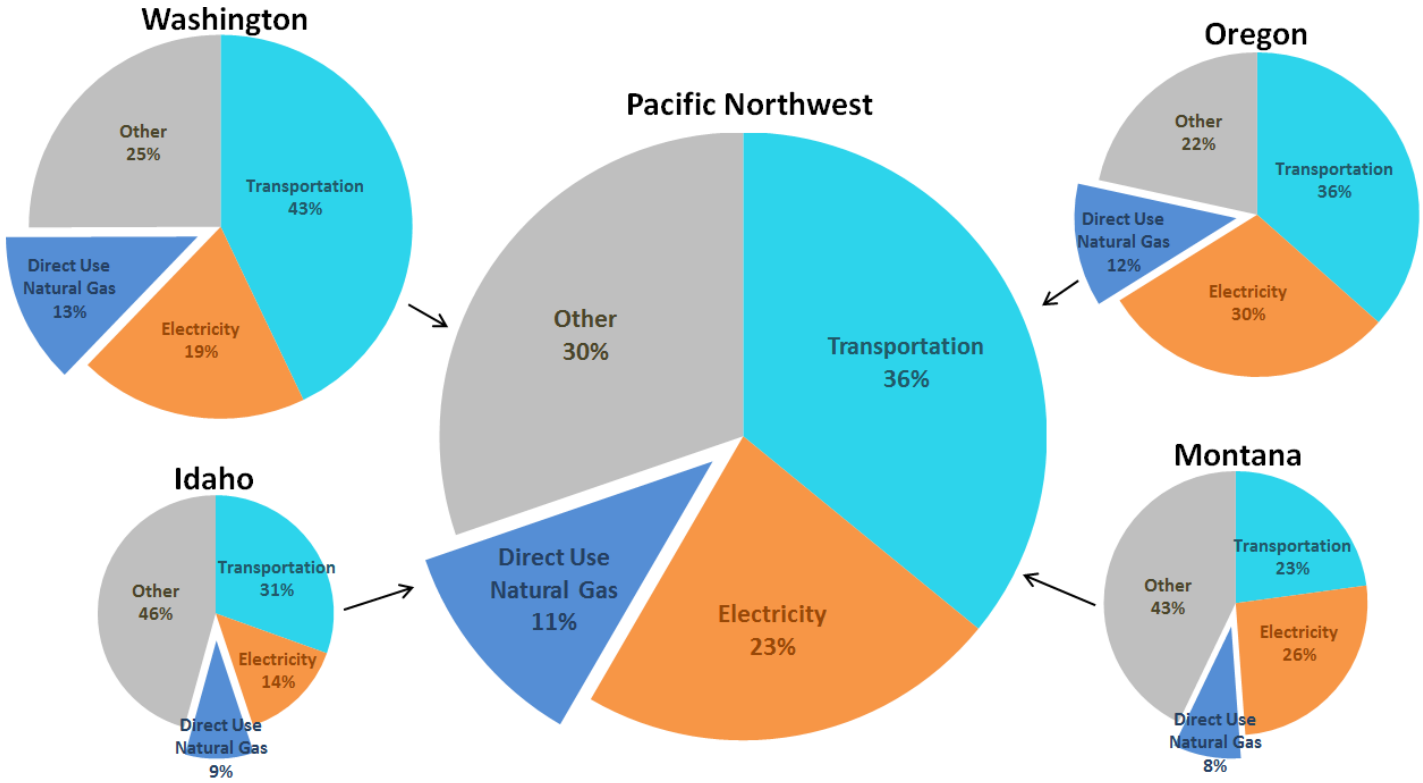
80%

Reduction in greenhouse gas emissions economy-wide by

2050

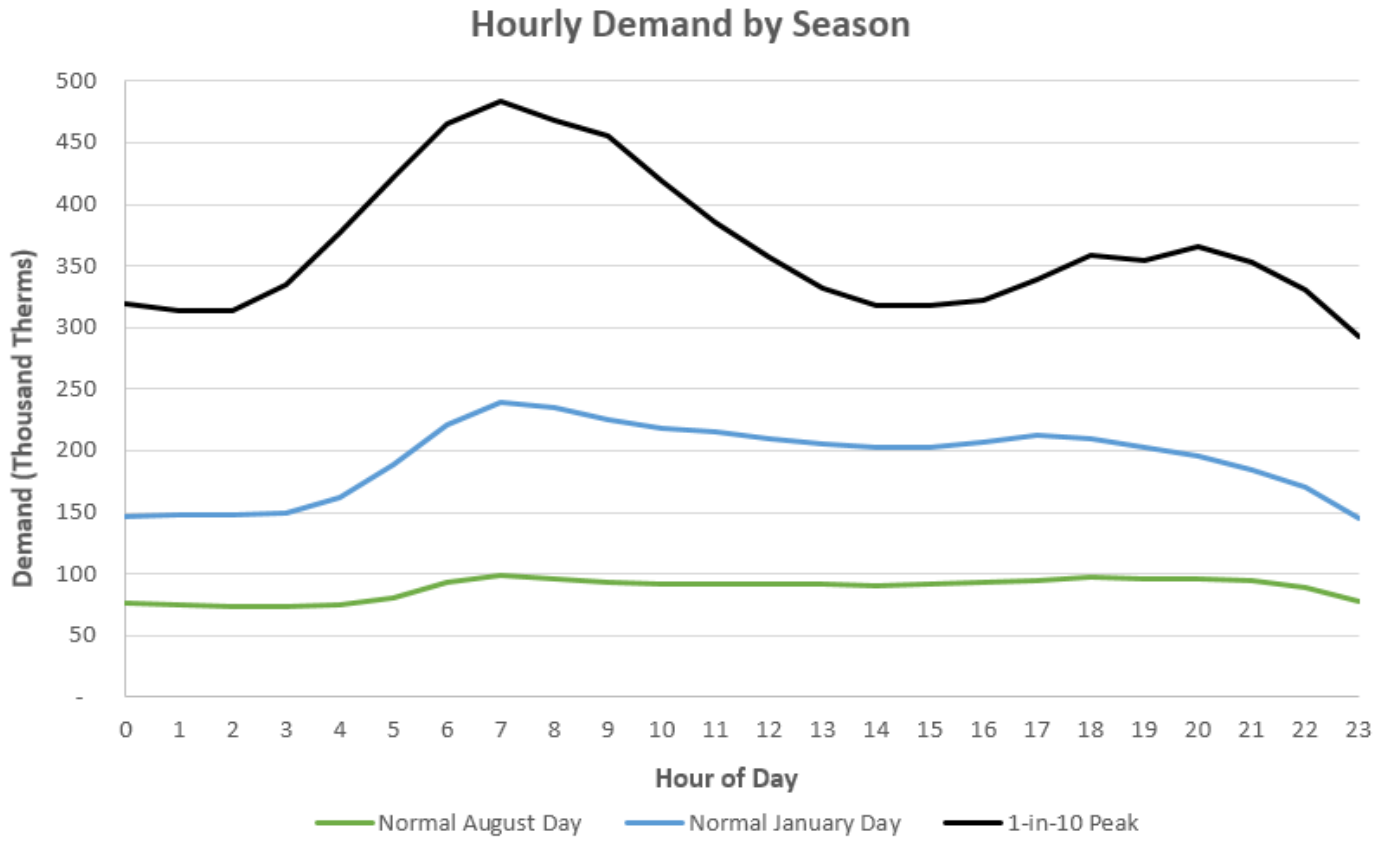


Current Regional Emissions



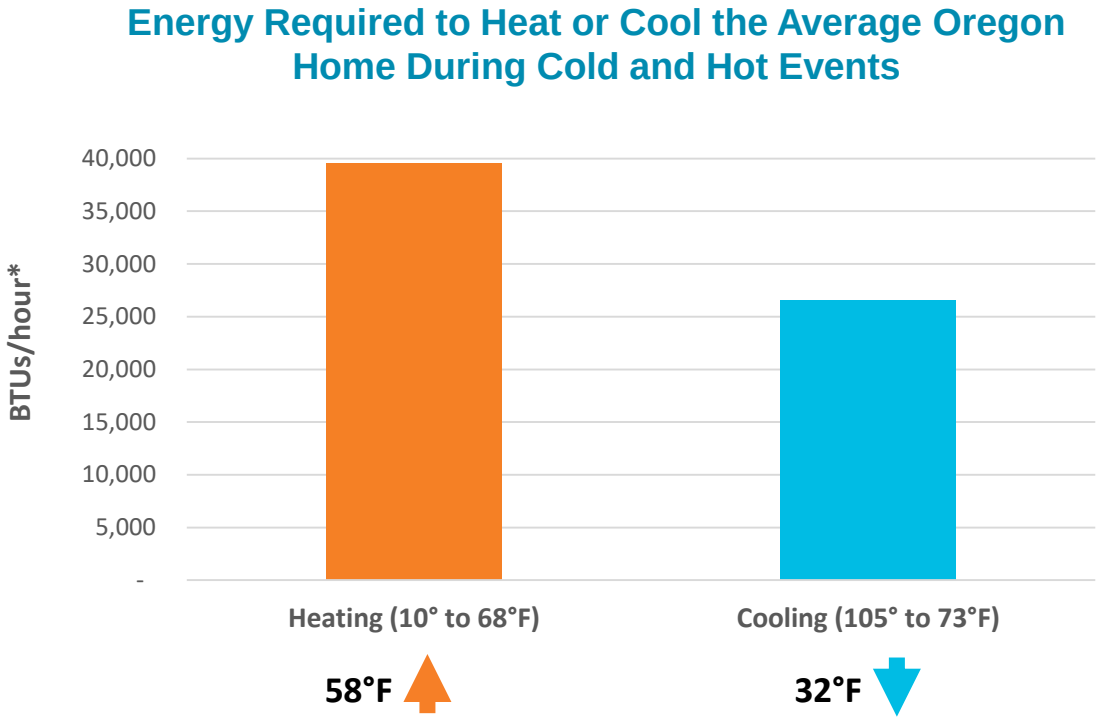
Pie sizes represent GHG emissions (in CO2 equivalent) of the state and the region. Source of data: latest year from the GHG emissions inventories published by the Oregon, Montana, and Idaho Department's of Environmental Quality and the Washington Department of Ecology

Direct Use Natural Gas Demand is Highly Seasonal and Peaky



What makes a peak? Extreme Weather

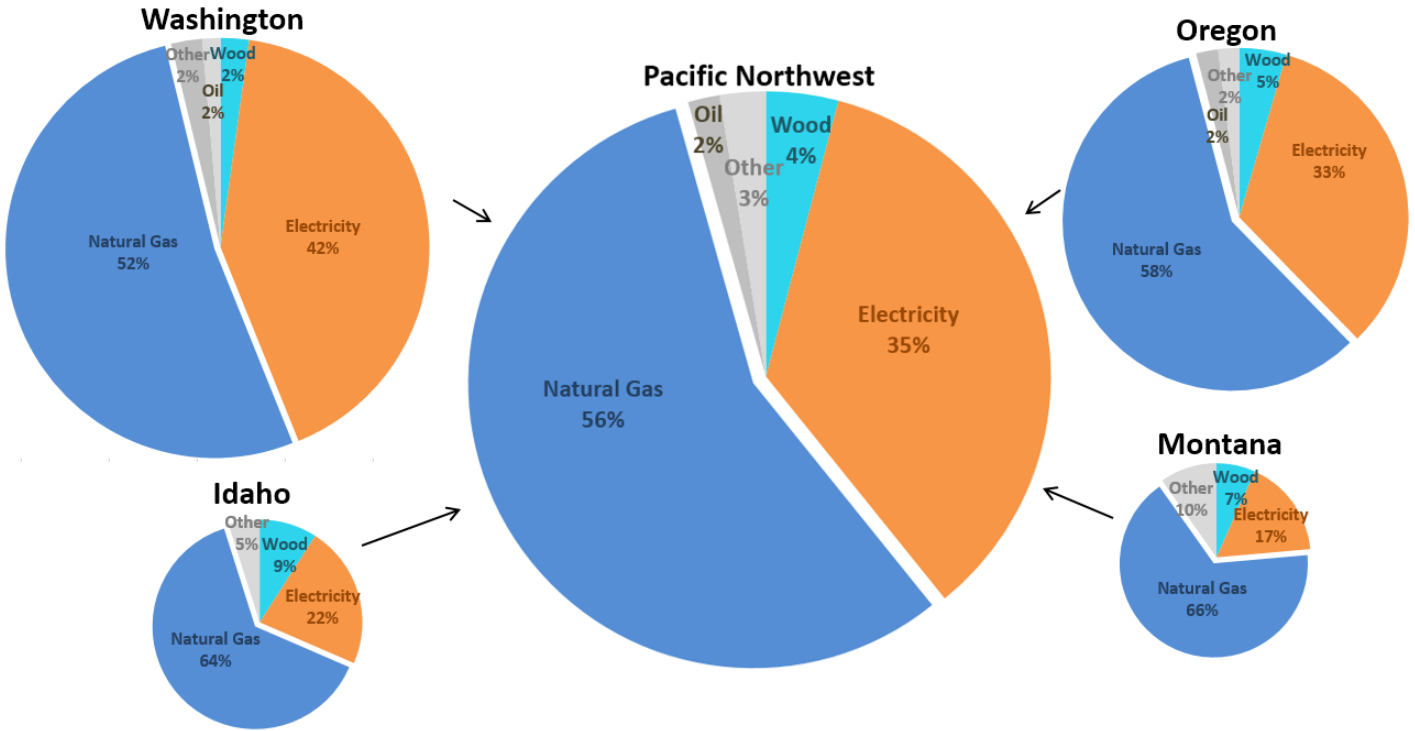
- Peak needs are typically driven by heating or cooling loads during extreme weather events
- For the majority of Americans more energy is required to heat their home during cold snaps than to cool it during heat waves
- When considering all energy use – not just electricity – the majority of the country is in a winter peaking climate



*Based upon energy needs of 2,000 square feet single family home with average shell efficiency. Shows the energy required to heat or cool a home, not the energy usage of the equipment used to provide those energy services

Residential Space Heating in the Pacific Northwest

E3 estimated that 68% of regional space heating needs are served by direct use natural gas, and less than 30% is currently served by electricity



Single family housing primary space heating system shown. Pie sizes are representative of relative number of housing units in the region. Source of data: 2016-2017 Northwest Energy Efficiency Alliance (NEEA) Residential Building Stock Assessment

Electric and Gas System Peaks Concurrent

Why is peak capacity so important for energy system planning?

You can't fly a plane over the mountains at average altitude.

Extreme weather example, January 2017:

- The region's electric system experienced the largest peak in recent years during the 7am hour with a load of less than **30 gigawatts.**
- During the same hour, the direct use of natural gas system in the Northwest also experienced its largest peak in recent years, and delivered about 1.8 million therms of natural gas to homes and businesses, which is equal to **53 gigawatts.**

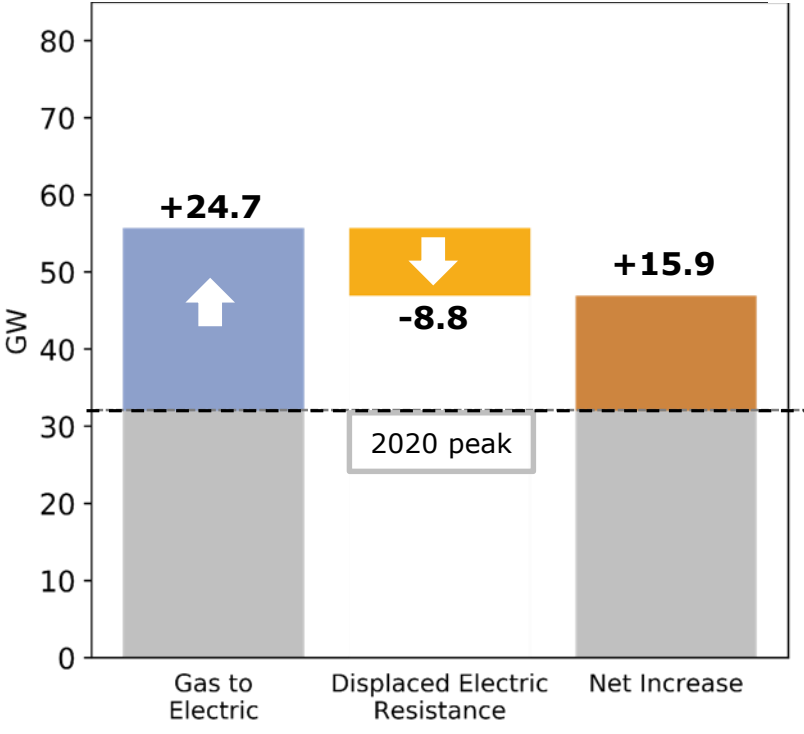
The natural gas system in the Northwest can deliver 98 gigawatts of energy on peak

- 3 times the current electric generating fleet that serves the region
- Roughly 100x the delivery capability of utility scale battery storage in the United States

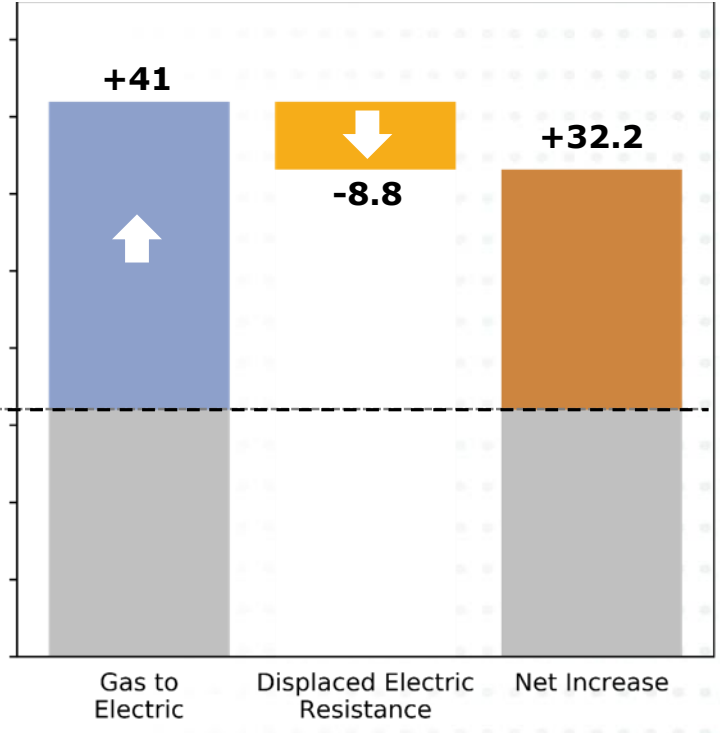
Electrification of space heating increases peak electricity demand

+ **New loads from electrification of space heating will, net of displaced resistance load, be incremental to existing peak demands**

Cold Climate Electric Heat Pump Scenario: 2050 Contribution to Northwest System Peak Demand (GW)



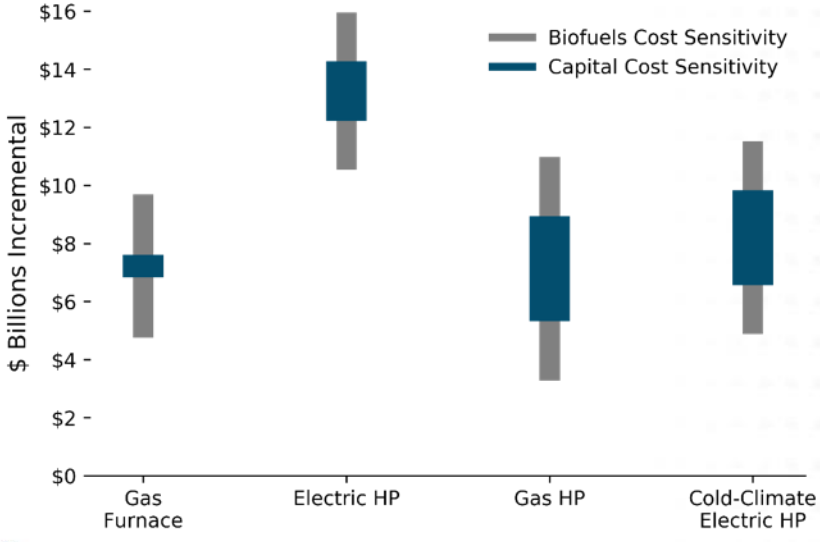
Electric Heat Pump Scenario: 2050 Contribution to Northwest System Peak Demand (GW)



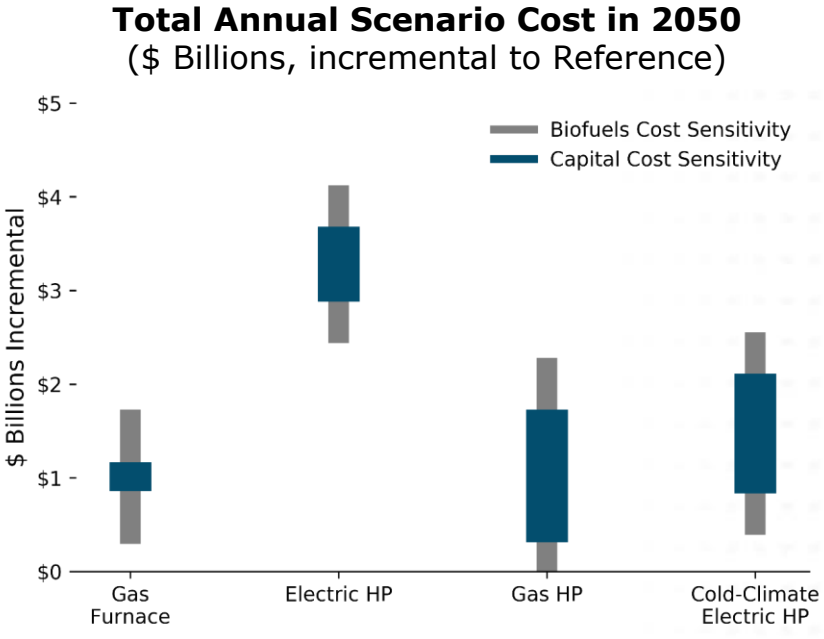
Economy-wide scenario costs in 2050 are similar for three scenarios, electric heat pump scenario is highest cost due to winter peak capacity need

+ **The 2050 economy-wide scenario costs range from $3 - $16 billion/year in 2050, relative to Reference scenario**
  - Equivalent to ~1% of projected 2050 regional Gross Domestic Product
+ **Cost forecasts are uncertain and sensitive to assumptions about technology costs for building heat equipment and biofuel prices**

Total Annual Scenario Cost in 2050
($ Billions, incremental to Reference)



Oregon incremental total scenario costs in 2050



+ Costs are lower in Oregon than Washington

- This is partially because Oregon is smaller than WA
- But Oregon also has much lower aviation emissions, leading to lower total biofuels demands/ biofuels price premiums

Renewable Natural Gas & Power to Gas

What is Renewable Natural Gas?

- RNG is *pipeline-quality gas* derived by cleaning up the biogases emitted as organic material chemically breaks down
- RNG has similar climate benefits to wind and solar energy

For NW Natural's system, RNG is:

- At least **97.3% methane**
- At least **985 BTUs/SCF**

Wastewater Treatment Plants

Landfills

Municipal Solid Waste

Wood Waste/Residue

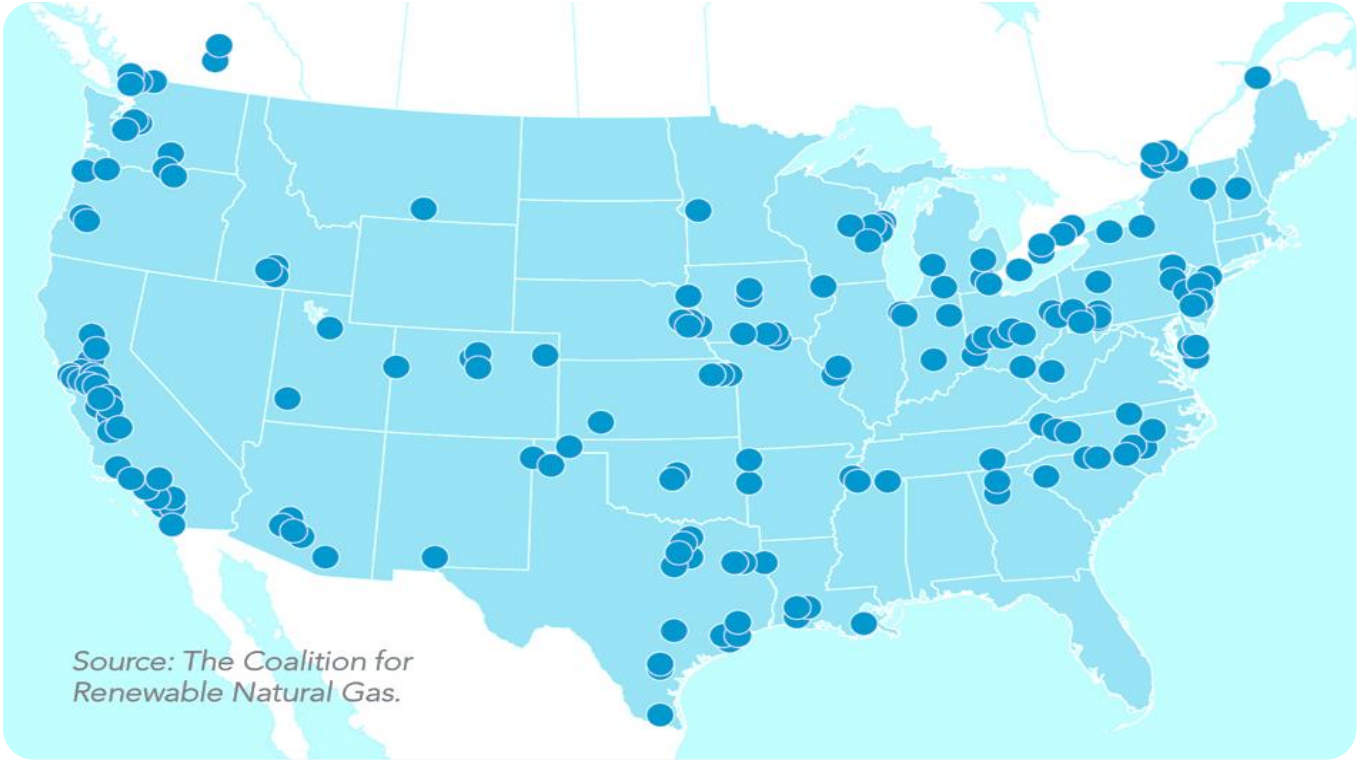
Animal Manures

Why Renewable Natural Gas?

- Reduces CO_2 emissions when used directly in appliances or in vehicles
  - NW Natural assumes future cost of carbon in all resource planning scenarios
  - Our customers desire lower carbon and renewable products
- RNG production turns costly waste products into revenue generators for cities and businesses
- On-system RNG potentially reduces infrastructure requirements, provides community resiliency benefits and reduces pipeline capacity contracts

Eugene-Springfield Water Pollution Control Facility
Photo source City of Eugene

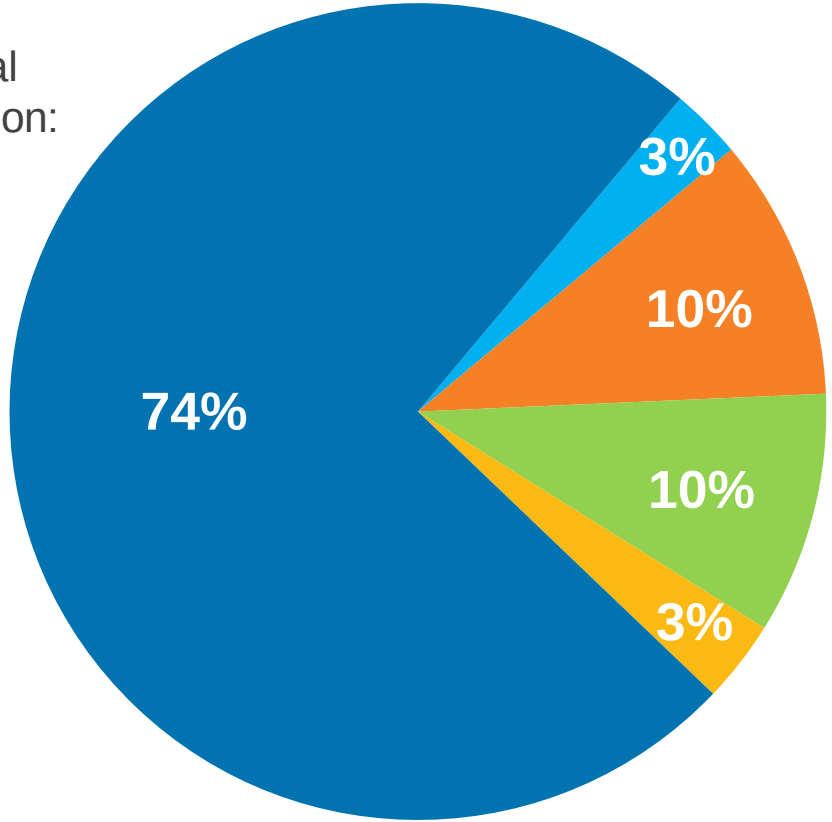
National Development Growing Rapidly



- 130 RNG facilities operating today in the U.S. and Canada
- Nearly 100 more are in development or under construction

Oregon RNG Technical Potential: 48 BCF

- Total OR direct annual natural gas consumption: **236 BCF**
- Total OR direct annual natural gas consumption by residential sector: **48 BCF**
- Total NWN annual natural gas sales: **65 – 75 BCF**



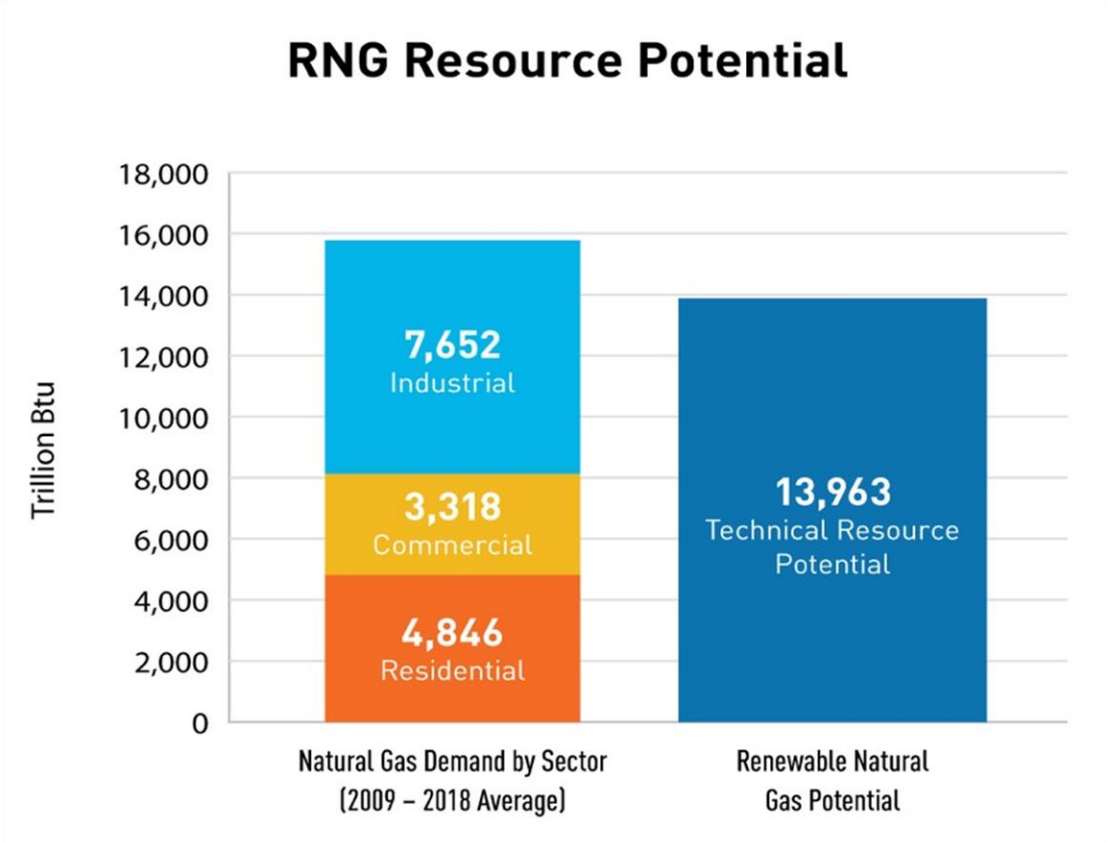
Oregon RNG Supply Sources

- Wastewater Treatment Plants
- Landfills
- Dairies
- Municipal Solid Waste
- Wood & Agricultural Residues

Source: Oregon Department of Energy: https://www.oregon.gov/energy/Data-and-Reports/Documents/2018-RNG-Inventory-Report.pdf

U.S. RNG Technical Potential

- ICF national study shows renewable natural as technical potential is **88% of current direct use throughput** (without power to gas)
- Study on technologies show **40% reduction in throughput from gas heat pumps** – making carbon neutral pipeline feasible



Source: ICF, American Gas Foundation, Dec 2019

Oregon Senate Bill 98

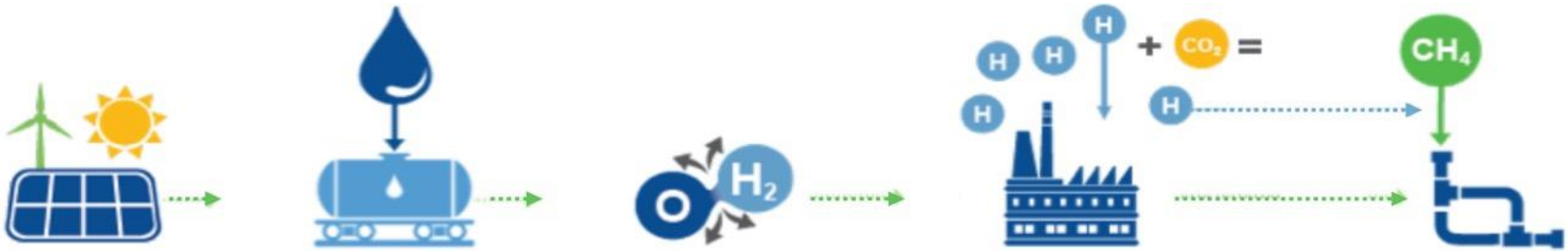
SB 98 Targets

Year	% of Sales Volume
2020 – 2024	5%
2025 – 2029	10%
2030 – 2034	15%
2035 – 2039	20%
2040 – 2044	25%
2045 – 2050	30%

- RNG can be procured from supply contracts, capital investments, or a combination of both, from inside or outside Oregon
- 5% of revenue requirement is annual budget cap; final rules adopted July 2020.
- Three RNG projects are in development now to serve vehicles initially – and will be online by 2021 (equivalent to 2% of our sales volume)
- Assessing ten more near-term projects regionally, which would collectively represent about 6% of our sales throughput
- Also pursuing long-term supply options in other parts of the U.S.

Power to Gas

Excess wind, solar, or hydro converted to renewable hydrogen for use in our pipeline system



excess renewable energy > goes through electrolysis > which splits the molecule > blends hydrogen directly into pipeline or methanate with waste carbon > can be used immediately or stored seasonally

100+ projects in Europe

3 projects in North America

Power to Gas

Pursuing Pilot Project in Eugene with these Partners:

EWEB

bef empowering business to be in balance

- Project would be first-of-its kind in U.S.; Memorandum of Understanding signed among parties, and project development underway
- Utilize excess renewable electricity to produce hydrogen to be methanated with waste CO_2 streams
- Blend into natural gas pipeline to decarbonize and offer long-term seasonal storage for renewables
- 2 – 10 MW project will utilize excess / low value renewable electricity from EWEB to generate hydrogen via electrolysis
- Final size will depend on total amount of waste CO_2 available

Hydrogen as Storage Solution

Problem: Seasonal renewable energy storage

One solution: pumped hydro

- Proposed **$2 billion** pumped hydro project near John Day Dam
- Could provide about **15,000 megawatt hours of storage**

Other solutions using existing gas infrastructure?

- NW Natural storage provides the equivalent of 4.7 million megawatt hours of storage – ***300x* the amount of that project**
- Can store renewable natural gas and blended / methanated renewable hydrogen
- Installing a Power to Gas facility to produce hydrogen with the same capacity as the pumped hydro project estimated at approx. **$360 million**[1]
- Thinking innovatively about gas system dramatically increases decarbonization options

[1]Using USDOE 2020 electrolyzer cost forecasts

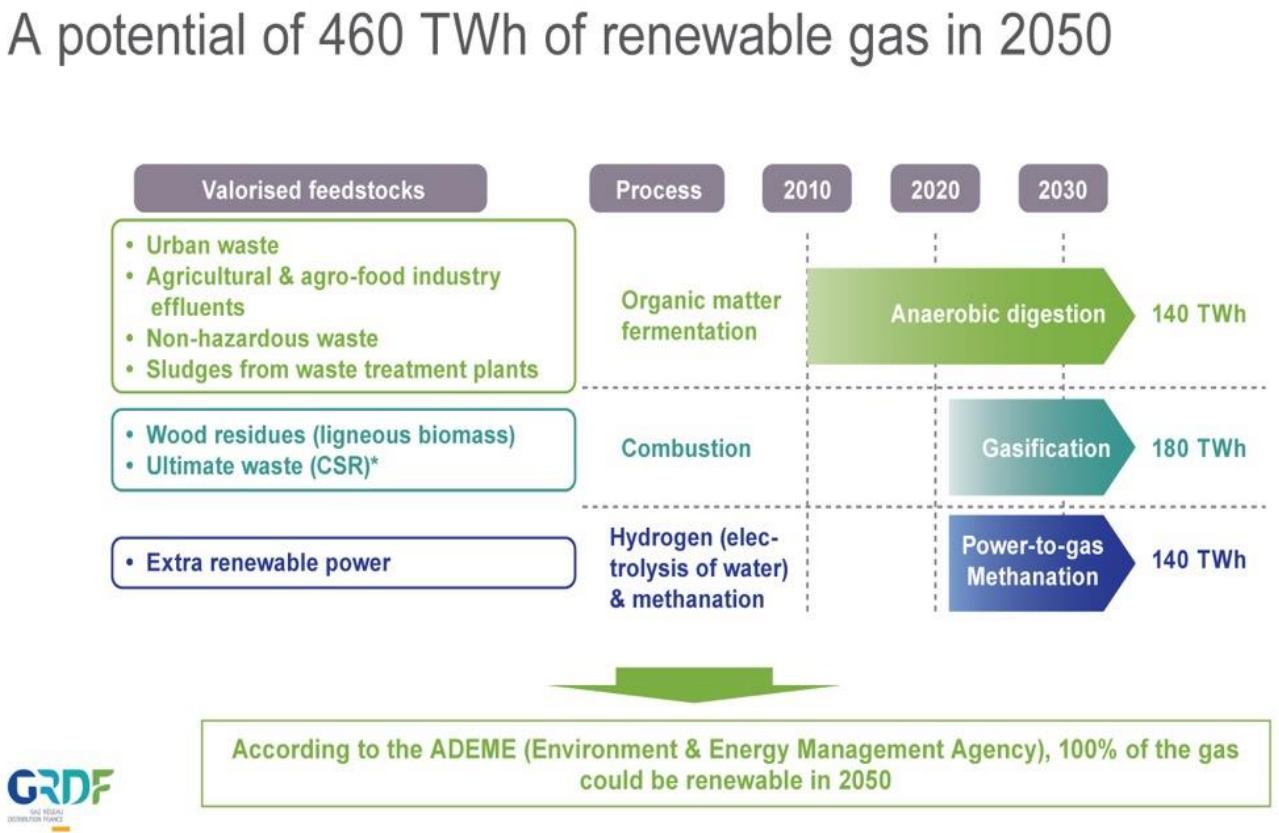
Closing

Europe Trip Learnings

- Gas networks undergoing transformational change to decarbonize, 5 to 10 years ahead of U.S. policy
- Initial focus to “electrify everything” but policymakers recognize it’s not a feasible – gas network delivers too much energy
- Increasingly committed to carbon neutrality by 2050
- Envision diversified use of the gas system:
  - Renewable natural gas
  - Blue hydrogen with CCU and CCS
  - Renewable hydrogen
  - Blended and dedicated hydrogen systems

France’s Vision for 100% Renewable Pipeline

- 1,000 renewable natural gas interconnections in France today
- With policy support, adding one a week
- Expect 3,000 RNG interconnections before 2030



Summarizing Our View

Energy policy has far-reaching consequences and requires unbiased analysis

- Consistent and transparent frameworks are needed for assessing lifecycle emissions for all energy sources
- Assumptions and data that drive decisions must be well vetted with subject matter experts

NW Natural embraces the change that's needed

- The Northwest can't meet climate goals without both the electric *and* gas systems
- Using infrastructure in place innovatively speeds progress and reduces costs

A diversified set of solutions is essential

- Electricity system capacity shortfall does not include electrification of buildings
- Two robust, decarbonizing energy systems reduces risk (gas equipment, district systems and fuel cells can work outages)

We're committed to a carbon neutral system by 2050

- With first-of-its kind legislation in place, renewable natural gas and renewable hydrogen give us the tools
- With lower use through energy efficiency and renewables in our system, there's no technical barrier

Thank you.